CLAIMS:

1. Discectomy apparatus for performing a discectomy of an intact or damaged intervertebral spinal disc, the intervertebral spinal disc having a disc body formed of a nucleus and annulus, through a trans-sacral axial bore extending cephalad and axially from a sacral position of a sacral vertebral body through one or more vertebral body and through a vertebral body endplate and axial disc opening into the nucleus of the intervertebral spinal disc, the apparatus comprising:

an elongated discectomy instrument having a discectomy instrument body extending between a discectomy instrument proximal end and instrument distal end, a cutting head located in a distal portion of the discectomy instrument, the instrument body and cutting head dimensioned to fit within and to extend through the axial bore, and means for extending the cutting head laterally away from the axial disc opening toward or through the annulus of the intervertebral spinal disc; and

operating means coupled to the instrument body proximal end for operating the cutting head to form a disc cavity within the annulus, the disc cavity extending laterally and away from the disc opening within the annulus, or to form a disc space by further extension of the disc cavity through at least a portion of the annulus.

2. The apparatus of Claim 1, further comprising aspiration means for aspirating the disc cavity or disc space.

3. The apparatus of Claim 1, wherein the cutting head comprises a fragmenting element for fragmenting the nucleus or annulus into fragments when operated by said operating means.

4. The apparatus of Claim 3, further comprising aspiration means for aspirating nucleus or annulus fragments from the disc cavity or disc space.

5. The apparatus of Claim 3, further comprising:

irrigation means for delivering irrigation fluid into the disc cavity or disc space; and

aspiration means for aspirating the nucleus fragments and irrigation fluid from the disc cavity or disc space.

6. The apparatus of Claim 3, wherein said operating means further comprising axially rotating means coupled to the discectomy instrument proximal end for rotating the laterally directed fragmenting element at least partially around the disc opening to sweep through the nucleus to fragment at least a portion of the nucleus to form a disc cavity extending laterally away from the axial disc opening and toward the annulus or to fragment a portion of the annulus to form a disc space extending away from the axial disc opening.

7. The apparatus of Claim 6, wherein the fragmenting element comprises a plurality of stiff brush elements attached to a distal end segment of the discectomy instrument body that are confined during introduction of the discectomy instrument through the axial bore and that extend radially outward at about 90° from the distal end segment of the discectomy instrument body and into the nucleus when passed through the axial disc opening, whereby rotation of the stiff brush elements through the nucleus fragments or compresses the nucleus.

8. The apparatus of Claim 6, wherein the fragmenting element comprises at least one cutting wire element attached to the distal end of the discectomy instrument body that is confined during introduction of the discectomy instrument through the axial bore and that extends radially outward at about 90° from the distal end of the discectomy instrument body and into the nucleus when passed through the axial disc opening and rotated, whereby the rotation of the cutting wire element through the nucleus fragments or compresses the nucleus.

9. The apparatus of Claim 8, wherein the cutting wire element comprises a weighted cutting wire element free end.

10. The apparatus of Claim 6, wherein the fragmenting element comprises at least two cutting elements attached to the distal end of the discectomy instrument body that are confined during introduction of the discectomy instrument through the axial bore and that extend radially outward at about 90° from opposed sides of the distal end of the discectomy instrument body and into the nucleus when passed through the disc opening and rotated, whereby the rotation of the cutting wire elements through the nucleus fragments or compresses the nucleus.

11. The apparatus of Claim 10, wherein each cutting wire element comprises a weighted cutting wire element free end.

12. The apparatus of Claim 1, wherein the laterally extending means further comprises a pull wire extending through a pull wire lumen of the discectomy instrument body extending from the discectomy instrument proximal end to the discectomy instrument distal end, the pull wire extending between a pull wire proximal end and a pull wire distal end attached in relation to the cutting head to orient the cutting head laterally within the disc cavity or disc space at an angle with respect to the discectomy instrument body within the axial bore.

13. The apparatus of Claim 12, wherein:

the discectomy instrument body further comprises a tubular discectomy instrument shaft, the discectomy instrument shaft having a shaft lumen extending between a discectomy instrument shaft proximal end and a discectomy instrument shaft distal end, the discectomy instrument shaft having a cutting tool deploying distal opening;

the cutting head comprises at least one fragmenting element fitted within the discectomy instrument shaft lumen that is retracted into alignment with the discectomy instrument shaft and is confined within the shaft lumen during introduction of the discectomy instrument through the axial bore and that is extendable outward from the deflection catheter distal lumen opening and into the nucleus; and

the operating means further comprises:

means for extending the fragmenting element through the distal lumen opening and outward from the discectomy instrument shaft; and

shaft rotating means coupled to the shaft proximal end for sweeping the fragmenting element at least partially around the disc opening to sweep through the nucleus to fragment at least a portion of the nucleus to form the disc cavity or disc space.

14. The apparatus of Claim 12, wherein:

the discectomy instrument body further comprises a tubular discectomy instrument shaft extending through said deflection catheter lumen, the discectomy instrument shaft having a shaft lumen extending between a discectomy instrument shaft proximal end and a discectomy instrument shaft distal end, the discectomy instrument shaft having a cutting tool deploying side opening;

the cutting head comprises at least one fragmenting element fitted within the discectomy instrument shaft lumen that is retracted into alignment with the discectomy instrument shaft and is confined within the deflection catheter lumen during introduction of the discectomy instrument through the axial bore and that is extendable outward from the side lumen opening and into the nucleus; and

the operating means further comprises:

means for extending the fragmenting element through the side opening and away from discectomy instrument shaft distal end; and

deflection catheter rotating means coupled to the deflection catheter proximal end for sweeping the fragmenting element at least partially around the disc opening to sweep through the nucleus to fragment at least a portion of the nucleus to form the disc cavity or disc space.

15. The apparatus of Claim 1, wherein the laterally extending means further comprises a deflection catheter having a deflection catheter lumen extending between a deflection catheter proximal and a deflection catheter distal end, wherein a distal portion of the deflection catheter is angled with respect to a proximal portion of the deflection catheter to orient the deflection catheter lumen distal end opening at about 90° with respect to the deflection catheter lumen in the proximal portion of the

deflection catheter and the discectomy instrument body and cutting head are extended through the deflection catheter.

16. The apparatus of Claim 15, wherein:

the discectomy instrument body further comprises a discectomy instrument shaft extending through said deflection catheter lumen having a discectomy instrument shaft proximal end and a discectomy instrument shaft distal end; and

the cutting head comprises at least one fragmenting element attached to the discectomy instrument shaft distal end that is confined within the deflection catheter lumen during introduction of the discectomy instrument through the axial bore and that is extendable radially outward at about 90° from the distal end of the discectomy instrument body and into the nucleus when extended from the deflection catheter lumen distal end opening; and

the operating means further comprises:

means coupled with said discectomy instrument shaft proximal end for selectively extending said fragmenting element out of said deflection catheter lumen end opening and laterally into the nucleus and toward the annulus; and

deflection catheter rotating means coupled to the deflection catheter proximal end for sweeping the laterally directed fragmenting element at least partially around the disc opening to sweep through the nucleus to fragment at least a portion of the nucleus to form the disc cavity or disc space.

17. The apparatus of Claim 16, wherein the cutting head comprises a cutting wire element.

18. The apparatus of Claim 17, wherein the operating means further comprises energy generating means for providing electrical energy to said cutting wire element to resistance heat said cutting wire loop to deliver thermal energy to the nucleus as the cutting wire element is swept through the nucleus.

19. The apparatus of Claim 16, wherein the cutting wire element comprises a weighted cutting wire element free end.

20. The apparatus of Claim 16, wherein the operating means further comprises ultrasonic energy source means coupled with said discectomy instrument shaft for applying ultrasonic energy to the fragmenting element.

21. The apparatus of Claim 15, wherein:

the discectomy instrument body further comprises a tubular discectomy instrument shaft extending through said deflection catheter lumen, the discectomy instrument shaft having a shaft lumen extending between a discectomy instrument shaft proximal end and a discectomy instrument shaft distal end, the discectomy instrument shaft having a cutting tool deploying side opening;

the cutting head comprises at least one fragmenting element fitted within the discectomy instrument shaft lumen that is retracted into alignment with the discectomy instrument shaft and is confined within the deflection catheter lumen during introduction of the discectomy instrument through the axial bore and that is extendable outward from the side opening and into the nucleus; and

the operating means further comprises:

means for selectively extending the fragmenting element out of the side opening and away from discectomy instrument shaft; and

deflection catheter rotating means coupled to the deflection catheter proximal end for sweeping the fragmenting element at least partially around the disc opening to sweep through the nucleus to fragment at least a portion of the nucleus to form the disc cavity or disc space.

22. The apparatus of Claim 15, wherein:

the discectomy instrument body further comprises a tubular discectomy instrument shaft extending through said deflection catheter lumen, the discectomy instrument shaft having a shaft lumen extending between a shaft lumen proximal end opening and a shaft lumen distal end opening;

the cutting head comprises at least one cutting wire extending distally from the shaft distal end to a cutting wire distal end that is extended into alignment with the discectomy instrument shaft and is confined within the deflection catheter lumen during

introduction of the discectomy instrument through the axial bore and that is extendable outward from the deflection catheter distal lumen opening and into the nucleus; and

the operating means further comprises:

a pull wire extending through the shaft lumen and coupled to the cutting wire distal end for forming a cutting wire loop by retraction of the pull wire into the shaft lumen; and

deflection catheter rotating means coupled to the deflection catheter proximal end for sweeping the cutting wire loop at least partially around the disc opening to sweep through the nucleus to fragment at least a portion of the nucleus to form the disc cavity or disc space.

23. The apparatus of Claim 1, wherein:

the discectomy instrument body further comprises:

a tubular discectomy instrument shaft extending through said deflection catheter lumen, the discectomy instrument shaft having a shaft lumen extending between a discectomy instrument shaft proximal end and a discectomy instrument shaft distal end, the discectomy instrument shaft having a cutting tool deploying opening; and

a drive shaft having a drive shaft body fitted within said shaft lumen and extending between a drive shaft proximal end extending proximally from said shaft proximal end and a drive shaft distal end extending distally from said shaft distal end;

the laterally extending means comprises means for deflecting said discectomy instrument shaft and said drive shaft through the disc opening to orient the fragmenting element transversely with respect to the axial bore;

the cutting head comprises a fragmenting element mounted to said drive shaft distal end, whereby the fragmenting element is laterally oriented toward the annulus of the spinal disc when extended from the axial bore through the axial disc opening; and

the operating means further comprises:

means for rotating said drive shaft to rotate said fragmenting element with respect to said instrument shaft to fragment the nucleus; and

instrument shaft rotating means coupled to the instrument shaft proximal end for sweeping the laterally directed fragmenting element at least partially around the disc opening to sweep through the nucleus to form the disc cavity or disc space.

24. The apparatus of Claim 23, wherein:

the deflecting means comprises a deflection catheter having a deflection catheter lumen extending between a deflection catheter proximal and a deflection catheter distal end, wherein a distal portion of the deflection catheter is angled with respect to a proximal portion of the deflection catheter to orient the deflection catheter lumen distal end opening at about 90° with respect to the deflection catheter lumen in the proximal portion of the deflection catheter and forms the means for extending the cutting head laterally; and

said discectomy instrument shaft, said drive shaft, and said fragmenting element are fitted within the deflection catheter lumen.

25. The apparatus of Claim 23, wherein the laterally extending means further comprises a pull wire extending through a pull wire lumen of the discectomy instrument body extending from the discectomy instrument proximal end to the discectomy instrument distal end, the pull wire extending between a pull wire proximal end and a pull wire distal end attached in relation to the cutting head to orient the cutting head laterally within the disc cavity or disc space at an angle with respect to the discectomy instrument body within the axial bore.

26. The apparatus of Claim 1, wherein:

the discectomy instrument body further comprises a tubular discectomy instrument shaft extending through said deflection catheter lumen, the discectomy instrument shaft having a fluid delivery shaft lumen extending between a discectomy instrument shaft proximal end and a discectomy instrument shaft distal end, the discectomy instrument shaft having a distal fluid delivery head having at least one fluid delivery port from said fluid delivery lumen;

the laterally extending means comprises means for deflecting said discectomy instrument shaft and said drive shaft through the disc opening to orient the distal fluid

delivery head laterally toward the annulus of the spinal disc when extended from the axial bore through the axial disc opening; and

the operating means further comprises:

means for applying fluid under pressure through said fluid delivery lumen and from the fluid delivery port as a fluid jet having a force sufficient to lyse the nucleus or annulus; and

instrument shaft rotating means coupled to the instrument shaft proximal end for sweeping the laterally directed fluid delivery head and port at least partially around the disc opening to sweep through and lyse the nucleus or annulus to form the disc cavity or disc space.

27. The apparatus of Claim 26, wherein:

the deflecting means comprises a deflection catheter having a deflection catheter lumen extending between a deflection catheter proximal and a deflection catheter distal end, wherein a distal portion of the deflection catheter is angled with respect to a proximal portion of the deflection catheter to orient the deflection catheter lumen distal end opening at about 90° with respect to the deflection catheter lumen in the proximal portion of the deflection catheter and forms the means for extending the cutting head laterally; and

said discectomy instrument shaft, said drive shaft, and said fragmenting element are fitted within the deflection catheter lumen.

28. The apparatus of Claim 26, wherein the laterally extending means further comprises a pull wire extending through a pull wire lumen of the discectomy instrument body extending from the discectomy instrument proximal end to the discectomy instrument distal end, the pull wire extending between a pull wire proximal end and a pull wire distal end attached in relation to the cutting head to orient the cutting head laterally within the disc cavity or disc space at an angle with respect to the discectomy instrument body within the axial bore.

29. The apparatus of Claim 1, wherein:

the cutting head comprises an elongated, flexible, wire assuming a planar spiral shape when unrestrained and capable of being straightened; and

the operating means further comprises means for selectively advancing the wire into the nucleus where the wire assumes the planar spiral shape with spiral turns pressing outward against and through the nucleus and toward the annulus to form the disc cavity or through the annulus to form the disc space.

30. The apparatus of Claim 29, further comprising means for rotating the wire at least partially around the disc opening to sweep the planar spiral shape through the nucleus to press through at least a portion of the nucleus or annulus to form the disc cavity or disc space.

31. The apparatus of Claim 29 further comprising energy source means coupled to the wire to apply energy through the wire in the spiral shape that desiccates the nucleus or the annulus contacted by the wire.

32. The apparatus of Claim 31, wherein the wire comprises a resistance heating element that is energized to delivery thermal energy to the nucleus.

33 32. The apparatus of Claim 31, wherein the wire comprises an electrocautery electrode that is energized to cauterise the nucleus.

34 33. The apparatus of Claim 1, wherein:

the cutting head comprises an elongated, flexible, wire assuming a planar spiral shape when unrestrained and capable of being straightened;

the laterally extending means further comprises a deflection catheter having a deflection catheter lumen extending between a deflection catheter proximal and a deflection catheter distal end, wherein a distal portion of the deflection catheter is angled with respect to a proximal portion of the deflection catheter to orient the

deflection catheter lumen distal end opening at about 90° with respect to the deflection catheter lumen in the proximal portion of the deflection catheter; and

the operating means further comprises:

means for selectively advancing the wire through said deflection catheter lumen and out of the catheter lumen distal end opening into the nucleus, whereby the wire assumes the planar spiral shape with spiral turns pressing outward against the nucleus and toward the annulus; and

deflection catheter rotating means coupled to the deflection catheter proximal end for sweeping the cutting wire at least partially around the disc opening to sweep the planar spiral shape through the nucleus to fragment at least a portion of the nucleus or annulus to form the disc cavity or disc space.

34. The apparatus of Claim 33, further comprising energy source means coupled to the wire extending through the deflection catheter lumen to apply energy to the spiral wire advanced into the nucleus that desiccates the nucleus or the annulus contacted by the wire.

35. The apparatus of Claim 34, wherein the wire comprises a resistance heating element that is energized to delivery thermal energy to the nucleus.

36. The apparatus of Claim 34, wherein the wire comprises an electrocautery electrode that is energized to cauterise the nucleus.

37. The apparatus of Claim 1, wherein:

the discectomy instrument body further comprises a tubular discectomy instrument shaft, the discectomy instrument shaft having a shaft lumen extending between a shaft lumen proximal end opening and a shaft lumen distal end opening,

the cutting head comprises at least one cutting wire extending distally from the shaft distal end to a cutting wire distal end that is extended into alignment with the discectomy instrument shaft and is confined within the axial bore during introduction of the discectomy instrument through the axial bore to locate the cutting wire extending

axially between cephalad and caudal axial disc openings to an intervertebral spinal disc;

the laterally extending means comprises a pull wire extending through the shaft lumen and coupled to the cutting wire distal end for forming a bowed out cutting wire loop by retraction of the pull wire into the shaft lumen, whereby the cutting wire is bowed laterally into the disc nucleus; and

the operating means further comprises shaft rotating means coupled to the shaft proximal end for sweeping the bowed out cutting wire loop at least partially around the disc openings to sweep through the nucleus to fragment at least a portion of the nucleus to form a disc cavity.

38. The apparatus of Claim 1, wherein:

the discectomy instrument body further comprises a tubular discectomy instrument shaft, the discectomy instrument shaft having a shaft lumen extending between a shaft lumen proximal end opening and a shaft lumen distal end opening,

the cutting head comprises a plurality of cutting wires extending distally from the shaft distal end to a common cutting wire distal end that are extended into alignment with the discectomy instrument shaft and are confined within the axial bore during introduction of the discectomy instrument through the axial bore to locate the cutting wires extending axially between cephalad and caudal axial disc openings to an intervertebral spinal disc;

the laterally extending means comprises a pull wire extending through the shaft lumen and coupled to the common cutting wire distal end for forming a plurality of bowed out cutting wire loops by retraction of the pull wire into the shaft lumen, whereby the cutting wires are bowed laterally into the disc nucleus and radially outward from the retracted pull wire; and

the operating means further comprises shaft rotating means coupled to the shaft proximal end for sweeping the bowed out cutting wire loops at least partially around the disc openings to sweep through the nucleus to fragment at least a portion of the nucleus to form a disc cavity.

40 39. The apparatus of Claim 1 wherein:

the cutting head comprises an energy emitting head located at the discectomy instrument body distal end;

the discectomy instrument further comprises energy delivery means for delivering energy to the energy emitting head; and

the operating means further comprises energy source means coupled to the energy delivery means for energizing the energy emitting head to apply energy to the nucleus that desiccates at least a portion of the nucleus to form the disc cavity or desiccates at least a portion of the annulus to form the disc space.

41 40. The apparatus of Claim 39, wherein the energy emitting head comprises a heating element that is energized to delivery thermal energy to the nucleus or annulus.

42 41. The apparatus of Claim 39, wherein the energy emitting head comprises an optical laser that is energized to delivery lasing thermal energy to the nucleus or annulus.

43 42. The apparatus of Claim 39, wherein the energy emitting head comprises an electrocautery electrode that is energized to cauterise the nucleus.

44 43. The apparatus of Claim 39, wherein the laterally extending means further comprises a deflection catheter having a deflection catheter lumen extending between a deflection catheter proximal and a deflection catheter distal end, wherein a distal portion of the deflection catheter is angled with respect to a proximal portion of the deflection catheter to orient the deflection catheter lumen distal end opening at about 90° with respect to the deflection catheter lumen in the proximal portion of the deflection catheter and the discectomy instrument body and energy emitting head are extended through the deflection catheter.

45 44. The apparatus of Claim 39, wherein the laterally extending means further comprises a pull wire extending through a pull wire lumen of the discectomy instrument body extending from the discectomy instrument proximal end to the discectomy instrument distal end, the pull wire extending between a pull wire proximal end and a pull wire distal end attached in relation to the energy emitting head to orient the energy emitting head laterally within the disc cavity or disc space at an angle with respect to the discectomy instrument body within the axial bore.

46 45. The apparatus of Claim 1, further comprising an elongated discectomy sheath having a sheath lumen extending between a sheath proximal end and a sheath distal end and having a sheath body length sufficient to extend from a skin incision through the trans-sacral axial bore to locate the sheath distal end at the disc opening, whereby the discectomy instrument is introduced to the axial disc opening through the sheath lumen.

47 46. The apparatus of Claim 1, further comprising:

an elongated discectomy sheath having a sheath lumen extending between a sheath proximal end and a sheath distal end and having a sheath body length sufficient to extend from a skin incision through the trans-sacral axial bore to locate the sheath distal end at the disc opening, whereby the discectomy instrument is introduced to the axial disc opening through the sheath lumen; and

aspiration means for aspirating nucleus or annulus fragments from the disc cavity or disc space means through the sheath lumen.

48 47. The apparatus of Claim 1, further comprising:

an elongated discectomy sheath having a sheath lumen extending between a sheath proximal end and a sheath distal end and having a sheath body length sufficient to extend from a skin incision through the trans-sacral axial bore to locate the sheath distal end at the disc opening, whereby the discectomy instrument is introduced to the axial disc opening through the sheath lumen;

irrigation means for delivering irrigation fluid into the disc cavity or disc space; and

aspiration means for aspirating nucleus or annulus fragments from the disc cavity or disc space means through the sheath lumen.

49 48. The apparatus of Claim 1, further comprising:

means for accessing a sacral position of a sacral vertebral body; and

means operable from the accessed sacral position for boring a trans-sacral axial bore cephalad and axially through the vertebral bodies of a series of adjacent vertebral bodies and any intervertebral, spinal discs and into or through the selected spinal disc providing at least a caudal axial disc opening into the nucleus of the selected spinal disc.

50 49. The apparatus of Claim 1, further comprising:

means for accessing an anterior sacral position of a sacral vertebral body; and

means operable from the accessed anterior sacral position for boring a trans-sacral axial bore cephalad and axially through the vertebral bodies of a series of adjacent vertebral bodies and any intervertebral, spinal discs and into or through the selected spinal disc providing at least a caudal axial disc opening into the nucleus of the selected spinal disc.

51 50. The apparatus of Claim 1, further comprising:

means for accessing a posterior sacral position of a sacral vertebral body; and

means operable from the accessed posterior sacral position for boring a curved trans-sacral axial bore cephalad and axially following the curvature of the spine through the vertebral bodies of a series of adjacent vertebral bodies and any intervertebral, spinal discs and into or through the selected spinal disc providing at least a caudal axial disc opening into the nucleus of the selected spinal disc.